Gitanyow Fisheries Authority

The 2008 Kitwanga-Cranberry River Watershed Restoration Project

Submitted to: **B.C. Ministry of Forests and Range**
Smithers, BC

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1. INTRODUCTION

The purpose of this report is to present the results of a wide variety of watershed restoration initiatives carried out in the Kitwanga River and Cranberry River watersheds in 2008. This project is the culmination of two years of information gathering by the Gitanyow Fisheries Authority (GFA) on fish passage status and sediment contribution at forestry road stream crossings. Background information can be found in the following reports, which are on file at the BC Ministry of Forests and Range (MoFR), Smithers, BC:

- The 2006 Kitwanga River Fish Passage-Culvert Inspection and the Stream Crossing Quality Index Project (McCarthy 2007),
- The 2006 Cranberry River Fish Passage-Culvert Inspection Project (McCarthy 2007)
- The 2007 Upper Kitwanga River Stream Crossing Assessment and Stream Crossing Deactivation Project (McCarthy 2008),
- Kitwanga River South Fish Passage-Culvert Inspection & Water Quality Effectiveness Evaluation Project 2007 (Koch and McCarthy 2008)

This project was completed in two phases. Phase 1 involved erosion control (grass seeding), fish habitat assessments (FHAP), and deactivation/structural replacement planning. Grass seeding was carried out early in the year on six sites located in the Kitwanga River Watershed and one site in the Cranberry River watershed that were identified as significant sediment sources in 2006 and 2007. FHAPs were carried out to collect background information on fish habitat quality from 11 stream crossings deemed as fish barriers (6 sites in the Kitwanga River watershed and 5 sites in the Cranberry River watershed). Phase 2 involved planning and implementing works based on benefits gained as determined in the Phase 1. In order to address erosion issues, complete deactivation was recommended for the West Kitwancool FSR (Site 91) and a Canoe Creek FSR branch road (Site 21, 277, 278, 279). Structural replacement (Site 3), culvert backwatering (Site 61) and erosion control (Site 60 and 48) was recommended for the Kitwanga FSR.

2. METHODS

2.1 Sedimentation and Erosion Control

Grass seed, fertilizer, and erosion control blankets (ECBs) were applied to approximately 3,000 m^2 of exposed surface area. An ECB is a straw mat held together with biodegradable

monofilament mesh and is fastened to the ground using 6-inch long metal staples. Grass seed was applied at a rate of approximately 350 kilograms per hectare and fertilizer was applied at a rate of approximately 100 kilograms per hectare as per supplier specifications. On flat to moderately sloped terrain, grass seed and fertilizer was applied before application of the ECBs. However, crews encountered several steep cutbanks with highly compacted soils and in these cases ECBs were applied before applying grass seed and fertilizer (Sites 35, 42, and 313). The ECBs were then shook lightly to allow seed and fertilizer to sift to the ground. This ensured that seed and fertilizer remained in position and not simply roll down the cutbank following application. All sites were revisited on at least two occasions where photos were taken and any bare spots were reseeded and fertilized.

2.2 Fish Habitat Assessments (FHAPs)

FHAPs were carried out to collect background information on fish habitat quality at stream crossings deemed as fish barriers. Methods were carried out following FHAP guidelines (Johnston and Slaney 1996) with particular emphasis on presence and location of natural barriers upstream of the crossing, from either permanent (bedrock-based) or temporary (rock/wood debris jams). Fish habitat data forms were completed for each reach encountered which includes stream size, habitat characteristics, riparian composition, and barrier presence. With this data each stream was described and ranked for its ability to provide spawning, rearing, over-wintering, and migration habitat.

3. RESULTS

Watershed restoration projects carried out in 2008 were divided into two categories: a) sedimentation and erosion control and b) fish passage restoration.

3.1 Sedimentation and Erosion Control

Sedimentation and erosion control plans involved the deactivation at 5 stream crossings (Kitwancool FSR Site 91, Canoe Creek Km 4 Branch Sites 21, 277, 278, 279), grass seeding at seven sites (Kitwanga Watershed Sites 14, 35, 42, 186, 313, 270; Cranberry Watershed Site 61), rock armoring (Kitwanga FSR Site 60), and landslide monitoring (Kitwanga FSR Site 48). All projects were completed except for the deactivation of the Canoe Creek Km 4 Branch Road as the early onset of winter prevented this work from being carried out. The following section provides a summary of conditions prior to and following treatment.

3.1.1 Deactivation of Site 91 - Kitwancool FSR Km 9.5

West Kitwancool Lake Forest Service Road (FSR) crosses this Gitanyow Lake tributary at approximately 9km from 26 Mile FSR (UTM 9U.555332.6133736). This stream is ranked as very important as a sockeye spawning ground is located adjacent to the stream outlet in Gitanyow Lake. The two culverts in place were insufficient to accommodate peak flows and there is strong potential for a road blowout (Jim Schwab, Pers. Comm.). Prior to deactivation both culvert outlets were suspended by approximately 1 meter and were continuously scouring the streambed below (Photo 1). The right bank culvert was completely blocked by rock debris, while the left bank culvert was partially blocked (Photo 2). Considerable mass wasting had occurred on the right bank immediately upstream of the crossing due to water being backed up by plugged culverts at least once in the past (Photo 3).

Bankfull width and depth were approximately 4 meters and 50 cm respectively and habitat can be described as riffle/pool/cascade complex. Past rock debris torrents are evident downstream as shown by frequent sediment wedges, which created several 1m+ waterfalls (Photo 4). In 2007, Gee traps were set to a 400-meter distance downstream of the crossing in optimal deep pool habitat. Overnight sets yielded no fish and no fish were sighted during the stream walks. Although this section was suspected to be non-fish bearing, the lower reaches near Gitanyow Lake likely support fish.

The prescription for this site was to remove the culverts and deactivate the crossing. Structural replacement was considered too costly for the NWFREP restoration funding available for 2008. Following project approval by the Gitanyow Hereditary Chiefs and the BC MoFR, the GFA and McElhanney Consulting Services prepared a detailed deactivation plan, which is presented in Appendix I. Works began on February 8th, 2009 and was completed in approximately 6 working days. Machinery on site included 2 excavators, a crawler tractor, and a dump truck. Machines excavated down to natural streambed and removed culverts in sections beginning at the downstream end (Photos 5 and 6). The stream banks and channel bed were then armored with riprap. An ATV trail was constructed on the upstream side of the crossing and the remaining approaches were graded to a 2H : 1V slope (Photo 7). All exposed soils were seeded with grass and fertilized, and the approaches leading to the stream were covered with straw mulch to aid seed germination (Photos 8 and 9).

Photo 1: Suspended culvert outlets at Site 91 prior to deactivation.

Photo 2: Partially blocked left culvert intake and completely blocked right culvert intake at Site 91 prior to deactivation.

Photo 3: Mass wasting on the upstream right bank at Site 91 prior to deactivation.

Photo 4: Waterfalls created by rock/wood debris jam at 150 meters downstream of the Kitwancool Lake FSR.

Photo 5: Start of Site 91 deactivation (February 8, 2009).

Photo 6: Removal of culverts and armoring of stream banks at Site 91 (February 11, 2008).

Photo 7: Construction of an ATV crossing over the upstream section of Site 91 (February 19, 2009).

Photo 8: Armored stream channel following the deactivation of Site 91 (February 25, 2009).

Photo 9: Grass seed and straw mulch applied to the stream banks following the deactivation of Site 91 (February 25, 2009).

3.1.2 Grass Seeding

Grass seeding was undertaken at seven sites deemed as significant sediment sources in 2006 and 2007 (Tables 1 and 2).

Table 1: List of sites treated for erosion and sedimentation in 2008.

Site #	Road Name	Stream Name	Northing	Easting	Crossing Issues
61	Tsugwinselda Creek Road	Unnamed	6144333	550775	Exposed soil from deactivation in 2007.
14	25 Mile Road	Kitwanga R. Trib 54	6140806	554141	Exposed soil from deactivation in 2007.
35	Kurtass Main	Kitwanga R. Trib 76	544916	6136884	Mass wasting on LRC.
42	Kitwanga FSR	Kitwanga R. Trib 74	545079	6137168	LRC wasting beside stream.
186	Mill Lakes FSR	Deuce Creek	6121095	555742	Exposed soil and mass wasting on RRC.
313	Mill Lakes FSR	Kitwancool Cr. Unnamed Trib.	6125419	553584	Mass wasting on RRC.
270	Tea Lake FSR	Tea Cr. Unnamed Trib.	6111232	563859	Exposed fine sediment from beaver pond upstream.

Table 2: Seeding area and grass seed application rate for the initial treatment of seven sites in 2008.

Site #	Treatment Date	Treatment Area (m^2)			Seed Applied (kg)	Seed Rate (kg/ha)
		Seed + ECB	Seed Only	Total		
61	May 22, 2008	240	100	340	12	353
14	May 23, 2008	80	100	180	6	333
35	May 26, 2008	200	100	300	12	383
42	May 26, 2008	160	100	260	9	354
186	May 27, 2008	0	1000	1000	23	230
313	May 28, 2008	80	50	130	6	442
270	May 27, 2008	0	100	100	2	230
Total		520	1450	1970	58	

The following section is a brief description of the 7 sites treated in 2008 including photos showing conditions before and after treatment. Addition photos, labeled by site number, can be found on CD in Appendix I.

3.1.2.1 Site 61 – Tsugwinselda Creek Road/ Cranberry River Unnamed Tributary

In 2006, Site 61 was identified as a fish barrier (McCarthy 2007, Photo 10) and was subsequently deactivated in 2007 (McCarthy 2008, Photo 11). Initial treatment of the disturbed site was undertaken on May 22nd, 2008 when grass seed, fertilizer, and erosion control blankets were applied to approximately 340 m^2 of exposed soil (Photos 12 to 15). This site is located 50 meters from Hwy 37 N and was revisited on six occasions throughout the growing season, mostly while on-route to other destinations (June 4th, 9th, 17th, 27th; August 19th; and October 1, 2008; additional photos on CD in Appendix I). By June 9th, a large portion of the grass seed had germinated and was beginning to penetrate through the ECBs. By June 27th most of the seed had germinated and by October 1st (final visit), the entire area was well vegetated. No further works are recommended for this site.

Photo 10: Suspended culvert outlet at Site 61 prior to deactivation (2006).

Photo 11: Exposed right bank following the 2007 deactivation of Site 61 (May 22, 2008).

Photo 12: Right bank seeded and covered with ECBs at Site 61 (May 22, 2008).

Photo 13: Well-vegetated right bank at Site 42 (August 19, 2008).

Photo 14: Exposed left bank following the 2007 deactivation of Site 61 (May 22, 2008).

Photo 15: Well-vegetated left bank at Site 61 (October 1, 2008).

3.1.2.2 Site 14 – 25 Mile Road/ Kitwanga River Tributary 54

In 2006, Site 14 was identified as a fish barrier (McCarthy 2007, Photo 16) and was subsequently deactivated in 2007 (McCarthy 2008, Photo 17). Initial treatment of the disturbed site was undertaken on May 23rd, 2008 when grass seed, fertilizer, and erosion control blankets were applied to approximately 200 m^2 of exposed soil (Photos 18 to 22). When revisited on July 17th, 2008 most of the grass seed had germinated and penetrated through the ECBs. By October 1st, 2008 (final visit) the entire site was considered completely vegetated. No further works are recommended for this site.

Photo 16: Suspended culvert at Site 14 prior to deactivation (October 2007).

Photo 17: Final stages of deactivation at Site 14 (October 2007)

Photo 18: Preparation of exposed right bank and piled road fill prior to treatment at Site 14 (May 22, 2008).

Photo 19: Right bank seeded and covered with ECBs at Site 14 (May 22, 2008).

Photo 20: Well-vegetated right bank at Site 14 (October 1, 2008).

Photo 21: Exposed left bank prior to treatment at Site 14 (May 22, 2008).

Photo 22: Well-vegetated left bank at Site 14 (October 1, 2008).

3.1.2.3 Site 35 - Kurtass Main/Kitwanga River Tributary 76

In 2007, Site 35 received a high WQEE score of 6.0 m3 (McCarthy 2008)). Mass wasting has occurred on a steep left road cutbank (85 percent slope approximately) adjacent to the stream channel (Photo 23). Initial treatment was undertaken on May 26th, 2008 when grass seed, fertilizer, and erosion control blankets were applied to approximately 450 m^2 (Photo 24). When revisited on July 17th, 2008 much of the seed had germinated but had yet to penetrate through the ECBs. By October 14th, 2008 (final visit) approximately 90 percent of the area treated with grass seed and ECBs was well vegetated (Photo 25). An adjacent area treated with grass seed only was less successful with approximately 50 percent coverage. No further works are recommended for this site.

Photo 23: Exposed left road cutbank at Site 35 prior to treatment (May 26, 2008).

Photo 24: GFA crew applying ECBs at Site 35 (May 26, 2008).

Photo 25: Well-vegetated treatment area at Site 35 (October 14, 2008).

3.1.2.4 Site 42 – Kitwanga FSR/ Kitwanga River Tributary 74

In 2007, Site 42 received a high WQEE score of 7.2 m^3 (McCarthy 2008). Similar to Site 35, mass wasting has occurred on a steep left road cutbank (85 percent slope approximately) adjacent to the stream channel (Photo 26). Initial treatment was undertaken on May 26th, 2008 when grass seed, fertilizer, and erosion control blankets were applied to approximately 200 m^2 (Photos 27 and 28). When revisited on July 17th, 2008 only a minor amount of grass seed had germinated and had yet to penetrate through the ECBs. By October 14th, 2008 (final visit) approximately 95 percent of the area treated with grass seed and ECBs was well vegetated (Photo 29). An adjacent area treated with grass seed only was less successful with approximately 30 percent coverage (Photo 29). No further works are recommended for this site.

Photo 26: Exposed left road cutbank at Site 42 prior to treatment (May 26, 2008).

Photo 27: GFA crew applying ECBs at Site 42 (May 26, 2008).

Photo 28: Left bank seeded and covered with ECBs at Site 42 (May 26, 2008).

Photo 29: Well vegetated treatment area at Site 42 (October 14, 2008)

Photo 30: Noticeable difference between seeded areas treated with ECBs (left) vs. seeded area treated without ECBs (right) at Site 42 (October 14, 2008).

3.1.2.5 Site 186 – Mill Lakes FSR/Deuce Creek

In 2007, Site 186 received a very high WQEE score of 514 m^3 (Koch and McCarthy 2008). The greatest sediment contributor was from four sections of mass wasting along the RRC (Photos 31 and 32). Initial treatment was undertaken on May 27th, 2008 when grass seed and fertilizer was applied to approximately 1000 m^2 of exposed soil. ECBs were not applied due to the irregular surface of this site (rills, rock, slumping). A best management practice for ECB installation involves smoothing the treatment area before application (Anonymous 2005), however this would have required the use of heavy equipment. By the time of the final visit on October 1st, 2008 it was estimated that 30 to 50 percent of the area was vegetated and these areas were scattered in clumps (Photos 33 and 34). This was the result of the downhill movement and concentration of seed and fertilizer into pocket depressions following application. GFA recommends that this site be smoothed (remove rills) and reseeded in early in 2009 and that the application of straw mulch and brush mats be included in the work plan. The straw mulch will aid in holding the seed and fertilizer in position until germination.

At the time of initial treatment sediment-laden groundwater was seeping out of the cutbanks and flowing down rills onto the road surface below. The ditch was completely filled with cutbank sediment (Photo 35). The GFA crew hand-shoveled a temporary ditch to direct water away from the road surface into a series of sediment retention ponds downslope (Photo 36). Although the temporary ditch remained intact until the final visit on October 1, 2008, it is anticipated that it will be filled with sediment during 2009 freshet and water will again flow over the road. GFA recommends that this ditch be reinstated properly and monitored regularly for infilling.

Photo 31: Exposed right road cutbank at Site 186 prior to treatment (looking across road; May 27, 2008).

Photo 32: Exposed right road cutbank at Site 186 prior to treatment (looking away from stream, May 27, 2008).

Photo 33: Partially vegetated right road cutbank following treatment (looking towards stream, October 1, 2008).

Photo 34: Partially vegetated right road cutbank following treatment (looking away from stream, October 1, 2008).

Photo 35: Ditch covered with cutbank sediment and water flowing over road surface at Site 186 (May 27, 2008).

Photo 36: GFA digging a temporary ditch at Site 186 prior to direct water into a series of small retention ponds (May 27, 2008).

3.1.2.6 Site 313 – Mill Lakes FSR Branch//Kitwancool Creek Unnamed Tributary

In 2007, Site 313 received a high WQEE score of 12 m^3 (Koch and McCarthy 2008). Mass wasting has occurred on a steep right road cutbank (90 percent slope approximately) adjacent to the stream channel (Photo 37). Initial treatment was undertaken on May 28th, 2008 when grass seed, fertilizer, and erosion control blankets were applied to approximately 130 m^2 (Photos 38). When revisited on July 17th, 2008 only a minor amount of grass seed had germinated and had yet to penetrate through the ECBs. By October 1st, 2008 (final visit) approximately 80 percent of the treatment area was well vegetated, however a large portion of grass cover had yet to penetrate through the ECBs (Photos 39 and 40). No further works are recommended for this site.

Photo 37: Exposed right road cutbank at Site 313 prior to treatment (September 25, 2007).

Photo 38: ECBs applied at Site 313 (May 26, 2008).

Photo 39: Right bank moderately vegetated at Site 42 (October 1, 2008).

Photo 40: Grass beginning to grow though ECBs at Site 42 (October 1, 2008)

3.1.2.7 Site 270 – Tea Lake FSR/Tea Creek Unnamed Tributary

In 2007, Site 270 received a WQEE score of 2 m^3 (moderate; Koch and McCarthy 2008). A beaver control cage was installed earlier in 2007 and there were exposed areas that were not re-vegetating (Photo 41). Initial treatment was undertaken on May 27th, 2008 when grass seed and fertilizer was applied to approximately 100 m^2 (Photo 42). ECBs were not used because natural vegetation (grass and horsetail sp.) was already becoming established. A follow-up visit on June 17th, 2008 showed that although some of the grass had germinated, it appeared the natural vegetation was dominating the treatment area. No further works are recommended for this site.

Photo 41: GFA crew applying grass seed and fertilizer to Site 270 (May 27, 2008).

Photo 42: Natural vegetation colonizing Site 270 (June 17, 2008).

3.1.3 Landslide Monitoring at Site 48 – Kitwanga FSR

In 2007, Site 48 was assessed erosion potential and received an extreme WQEE score of 303 m^3 (McCarthy 2007). A mass movement event occurred sometime between the fall of 2006 and the spring of 2007. A large fracture extends across the Kitwanga FSR where a road section dropped approximately 60 centimeters (Photo 43). Downstream of this crossing multiple horizontal fractures measuring 20 to 30 meters in length extend down-slope for approximately 30 meters. The uppermost horizontal fracture has reached the stream 15 meters downstream of culvert crossing. Further down-slope of these fractures is an active landslide measuring approximately 100 meters long x 30 meters wide at a 55 percent slope (Photo 44 and 45). Upslope of the Kitwanga FSR a continuous fault line extended south through the forest, east across the stream and into a cutblock, and then turned back towards the Kitwanga FSR to the north (Photo 46).

MOF Geomorphologists and GFA Biologists visited this site on June 20th, 2008 and it was agreed that sediment is accumulating at the confluence and entering the stream. However, this landslide appeared to be progressing slowly and at minimum this site should be monitored regularly, particularly during the fall rainy period and the spring thaw period.

As a simple means of monitoring slope movement, two lines of stakes (2" x 2" x 3') were driven in the ground at 2-meter intervals (horizontal distance). The vertical drop and the slope distance were measured between every stake (Photos 47 and 48). Line 1 consisted of 50 stakes, which extended 100 meters horizontal (115 meters slope distance) from the top to the bottom of the slide (vertical drop of 59 meters or 59 percent overall slope; Table 3; Photo 49). Every 10th stake was flagged and a reference post was erected, flagged and labeled in stable ground outside the slide area and perpendicular to the line direction. The line direction facing downhill was 345 degrees therefore the direction to the reference stakes was 255 degrees from the line center.

Line 2 was placed parallel to and 4 meters to the left of Line 1 (facing downhill). Line 2 consisted of 16 stakes, which extended 32 meters horizontal (38 meters slope distance) from the top to the bottom of the uppermost slide area (vertical drop of 18.4 meters or 57 percent overall slope; Table 4; Photos 50 and 51). An unstable hillslope posed a safety hazard and prevented the placement of additional stakes. A large number of photographs were taken during this project and can be found on CD in Appendix III (sorted by date). GFA recommends that the landslide area be reassessed after freshet in 2009. After stakes are re-measured, data will provide information where mass

movement is most prevalent. A slope stabilization plan should then be prepared that will provide the most benefit to this site.

Table 3: Line 1 stake spacing measurements at Site 48 (October 17, 2008).

From Stake #	To Stake #	Horiz. Dist. (m)	Vert. Dist. (m)	Slope (%)	Slope Dist. (m)	From Stake #	To Stake #	Horiz. Dist. (m)	Vert. Dist. (m)	Slope (%)	Slope Dist. (m)
POC	1	2.00	1.90	95		25	26	2.00	0.75	38	2.14
1	2	2.00	0.98	49	2.11	26	27	2.00	1.12	56	2.34
2	3	2.00	1.40	70	2.41	27	28	2.00	1.32	66	2.47
3	4	2.00	1.06	53	2.49	28	29	2.00	1.19	60	2.34
4	5	2.00	1.40	70	2.47	29	30	2.00	0.81	41	2.11
5	6	2.00	1.81	91	2.86	30	31	2.00	0.99	50	2.2
6	7	2.00	1.47	74	2.45	31	32	2.00	1.31	66	2.31
7	8	2.00	0.99	50	2.16	32	33	2.00	1.32	66	2.45
8	9	2.00	0.90	45	2.24	33	34	2.00	1.23	62	2.35
9	10	2.00	0.92	46	2.22	34	35	2.00	1.10	55	2.33
10	11	2.00	1.02	51	2.11	35	36	2.00	1.45	73	2.41
11	12	2.00	0.90	45	2.18	36	37	2.00	1.13	57	2.37
12	13	2.00	1.32	66	2.38	37	38	2.00	1.30	65	2.26
13	14	2.00	1.47	74	2.5	38	39	2.00	1.12	56	2.26
14	15	2.00	0.96	48	2.35	39	40	2.00	1.13	57	2.31
15	16	2.00	0.51	26	2.11	40	41	2.00	1.23	62	2.37
16	17	2.00	0.59	30	2.14	41	42	2.00	1.35	68	2.47
17	18	2.00	0.77	39	2.16	42	43	2.00	1.52	76	2.59
18	19	2.00	1.16	58	2.26	43	44	2.00	1.83	92	2.64
19	20	2.00	1.42	71	2.68	44	45	2.00	1.62	81	2.63
20	21	2.00	1.23	62	2.69	45	46	2.00	1.45	73	2.5
21	22	2.00	1.00	50	2.25	46	47	2.00	0.79	40	2.1
22	23	2.00	0.95	48	2.18	47	48	2.00	1.24	62	2.37
23	24	2.00	1.16	58	2.79	48	49	2.00	1.31	66	2.36
24	25	2.00	0.73	37	2.09	49	50	2.00	1.30	65	2.4
						Total		100.00	58.93		115.36
						Average				59	

Table 4: Line 2 stake spacing measurements at Site 48 (October 28, 2008).

From Stake #	To Stake #	Horiz. Dist. (m)	Vert. Dist. (m)	Slope (%)	Slope Dist. (m)
51	52	2.00	0.80	40	2.17
52	53	2.00	1.85	93	2.8
53	54	2.00	1.58	79	2.6
54	55	2.00	1.45	73	2.52
55	56	2.00	1.52	76	2.6
56	57	2.00	1.50	75	2.55
57	58	2.00	1.20	60	2.38
58	59	2.00	0.94	47	2.35
59	60	2.00	1.05	53	2.14
60	61	2.00	0.70	35	2.15
61	62	2.00	0.95	48	2.25
62	63	2.00	1.56	78	2.4
63	64	2.00	1.30	65	2.51
64	65	2.00	0.90	45	2.15
65	66	2.00	0.69	35	2.18
66	67	2.00	0.40	20	2.1
Total		32.00	18.39		37.85
Average				57	

Photo 43: Road fracture along the Kitwanga FSR (October 4, 2007).

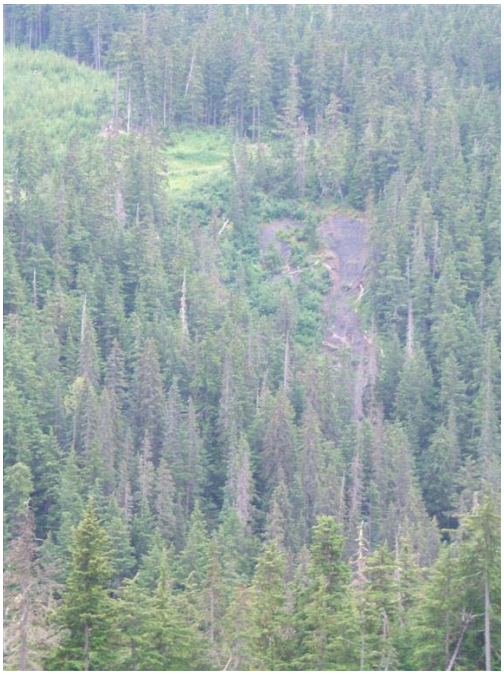

Photo 44: Slope failure at Site 48 viewed across the valley from Ronald McDonald FSR (July 13, 2007)

Photo 45: Slope failure looking downhill towards the Upper Kitwanga River (October 4, 2007)

Photo 46: Fault line through the forest upslope of the Site 48 road crossing.

Photo 47: Line 1 stake placement at Site 48 (October 17, 2008).

Photo 48: Line 1 stake placement using 2-meter level at Site 48 (October 17, 2008).

Photo 49: Completed staking of Line 1 at Site 48 (October 21, 2008).

Photo 50: Completed staking of Line 2 looking downhill at Site 48 (October 28, 2008).

Photo 51: Completed staking of Lines 1 and 2 looking uphill at Site 48 (October 28, 2008).

3.1.4 Rock Armoring at Site 60 – Kitwanga FSR

The culvert outlet at Site 60 was suspended 2.3 m above the streambed (Photo 52) and the intake was partially blocked by rock/wood debris. Considerable mass wasting has occurred below and beside the culvert outlet. The stream passes through a 900mm culvert, which was sufficient to accommodate peak flows (Jim Schwab, Pers. Comm.). In 2007, Gee traps did not catch any fish to a 50-meter distance both upstream and downstream of the crossing. This section was suspected to be non-fish bearing as the average gradient between the road crossing and the Upper Kitwanga River based on 1:20,000 TRIM contour intervals was estimated at 27 percent (80 m rise / 300 m run). Electrofishing is required to confirm fish bearing status.

GFA recommended the placement of boulder riprap below the culvert outlet to eliminate streambed scouring. Works began with the installation of a temporary overhead trough to divert water away from the work site (Photo 53). The streambed and eroding side banks were then lined with geotextile held in position by 2" x 2" stakes (Photo 54). A haul truck delivered one load of rock to the site and a small size excavator placed the rock in position below the culvert (final photos are not available for this report). No further works are recommended at this site.

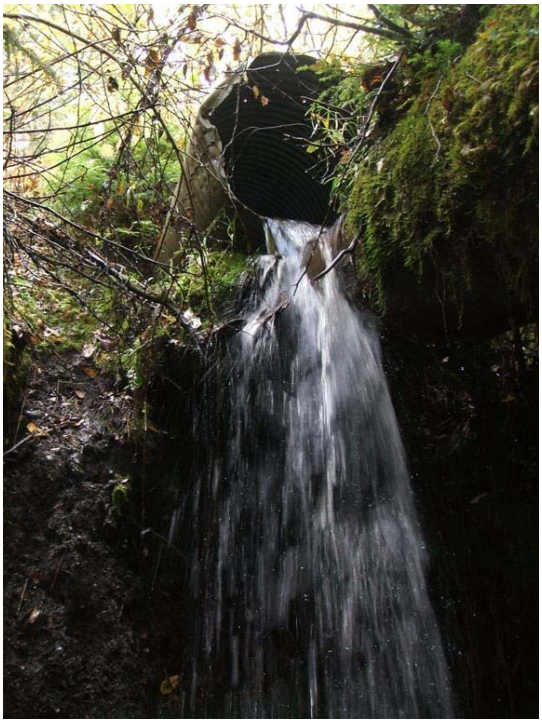

Photo 52: Suspended culvert outlet at site 60.

Photo 53: Diversion trough constructed to bypass water away from Site 60.

Photo 54: Eroding stream bank covered with Geotextile at Site 60.

3.1.5 Deactivation of Sites 21, 279, 278, and 277 – Canoe Creek FSR 4 Km Branch

Site 21, 279, 278, and 277 are located near the Tea Creek headwaters along a branch of the Canoe Creek FSR. Muddy road surfaces and exposed cutbanks were contributing a significant amount of sediment into adjacent streams (McCarthy 2007, Koch and McCarthy 208; Photos 55 to 58). In the fall of 2006, all stream were dry, however they were flowing near bankfull in when revisited in the fall of 2007 and the summer of 2008. It is assumed that these streams provides seasonal habitat to cutthroat trout, which were captured in large number by Gee traps set approximately 2 km downstream in a large beaver pond complex. FHAPs were carried out on two of the larger streams (Sites 21 and 278) where collapsing wood-box culverts were creating potential fish barriers (FHAP site cards are presented digitally in Appendix III). Although no fish were captured or sited during stream walks, deactivation should still proceed for erosion control.

When Site 21 was assessed for erosion potential in 2006, it scored 6.2 (extremely high ranking) using the SCQI method with the road surface and cut banks as the major contributors. After a FHAP was undertaken in the summer of 2008, this steam was classified as a S3 stream and consisted of continuous shallow riffle/pool complexes. Habitat quality was similar for all reaches assessed (riffle/pool morphology), except for a series of abandoned beaver ponds downstream of the crossing.

When Site 278 was assessed for erosion potential in 2007, sedimentation was occurring at this site from a variety of sources (WQEE score = 1.3 m^3 – moderate ranking), however both road surfaces were the biggest contributors. After a FHAP was undertaken in the summer of 2008, this stream was classified as an S4 stream. Habitat quality was similar for all reaches (riffle/pool morphology).

At Sites 277 and 279, both small seasonal streams, open-bottom wood box culverts were collapsing into the streambed below similar to Site 21.

GFA recommended that these four road crossings be deactivated and re-vegetated between the Canoe Creek FSR junction and Site 277 (total distance of 3 km). Following project approval by the Gitanyow Hereditary Chiefs and the BC MoFR, the GFA and McElhanney Consulting Services prepared a detailed deactivation plan (Appendix II). The early onset of winter and a

deep snow pack prevented the deactivation of this site. GFA recommends that this road be deactivated following freshet in the 2009 field season.

Photo 55: Wood box culvert collapsing into stream at Site 21.

Photo 56: Muddy road surface at Site 279.

Photo 57: Muddy road surface at Site 278.

Photo 58: Collapsing wood box culvert at Site 277.

3.2 Fish Passage Restoration

Fish passage restoration works were carried out at five crossing sites located in the Kitwanga Watershed (Sites 3, 61 – Kitwanga FSR; Sites 21, 278 – Canoe Creek Km 4 Branch Road; and Site 347 – 13 Mile Road) and three sites located in the Cranberry Watershed (Site 47 – Mitten Main; and Sites 38, 60 - Wagon Creek Road). FHAPs were completed on all sites except for those located along Wagon Creek due to the poor likelihood that those streams were fish bearing. Digitized FHAP data forms are presented on CD in Appendix I. After review of the FHAP results it was decided that worthwhile benefits would be gained with the restoration of Site 3 (structural replacement) and Site 61 (culvert backwatering). Deactivation was recommended for Sites 21 and 278 based on sedimentation issues as described in previous sections.

3.2.1 Site 3 – Kitwanga FSR/Chernobel Creek

In 2006, Site 3 was assessed as a partial fish passage barrier and ranked as a moderate priority crossing (FPCI Score= 28). The Kitwanga FSR crosses Cher Nobel Creek (9U.550290.6140698) approximately 4 kilometers west of Hwy 37 North/26 Mile Road intersection. This crossing consisted of two 900 mm culverts placed side by side and was considered a partial barrier due to the excessive water velocity inside the culvert (Photos 59 and 60). The culvert slopes were considered excessively steep (3 percent) creating high water velocity (1.57 meters/sec), which exceeded the swimming capability of juvenile salmonids. A deep scour pool below the culvert provided good fish habitat.

At the time of the 2006 assessment, three cutthroat trout were captured in "Gee" traps below the culvert, while 2 cutthroat trout were captured upstream. The stream habitat value within 50 meters of the road crossing was considered poor since it was comprised mainly of shallow riffles with minimal deep pools. The total length of stream barred was estimated at 1.8 kilometers based on 1:20,000 TRIM, representing 31 percent of the total stream length, and the average gradient of the barred section was approximately 10 percent.

In 2008, a FHAP was carried out on Chernobel Creek to 1.5 kilometers upstream of the crossing. Fish habitat was considered good throughout the surveyed reaches with abundant large and small woody debris (LWD, SWD), deep pools (DP), undercut banks (UB), and overstream vegetation (OV). No bedrock-based barriers were encountered. The stream crosses two deactivated roads at 865 meters (9U.550020.6139963) and 1500 meters (9U.550035.6139447). At the crossing at 1500 meters, a rock debris jam has formed immediately downstream causing more than half of

the stream to flow through a young cutblock for a distance of 400 meters before reentering the original channel (Photos 61 and 62). More details can be found from digitized FHAP forms in Appendix III.

A reconnaissance walk was carried out downstream of the crossing to investigate a possible mapping error. The 1:20,000 shows Chernobel Creek as flowing towards the Upper Kitwanga River then running roughly parallel to it before entering the mainstem within 1 kilometer of Gitanyow Lake. However, the map shows Chernobel Creek crossing the Kitwanga FSR at Site 5, which was found to be only of a stagnant beaver pond with minimal flow. The mapping error was confirmed when the stream was found to join the Upper Kitwanga River approximately 200 meters upstream of the Weber FSR (9U.5506501.6141158). Approximately 100 meters upstream of the confluence the stream entered an abandoned side channel of the Upper Kitwanga River where large numbers of coho fry were observed. With this finding, the FPCI score determined in 2006 was underestimated as the percentage of stream barred increases and the discovery of juvenile coho salmon results in multiple salmonid species present.

Culvert replacement was recommended for this site. Funding was only available for the preparation of detailed site plan. McElhanney Consulting Services was contracted to complete this plan, which involves the installation of an open-bottom arch culvert. This site plan was submitted as a supplemental document to this report and is on file at the BC MoFR, Smithers.

Photo 59: Culvert outlets at Site 3 (Kitwanga FSR).

Photo 60: Partially plugged culvert inlets at Site 3 (Chernobel Creek).

Photo 61: Rock/wood avulsion diverting flow into cutblock at upstream end of Reach 5 (Chernobel Creek).

Photo 62: Chernobel Creek flowing through cutblock in Reach 5.

3.2.2 Site 61- Kitwanga FSR/Unnamed Upper Kitwanga River Tributary

In 2007, Site 61 was assessed as a partial barrier and ranked as a moderate priority crossing (FPCI Score= 31). Kitwanga FSR crosses this unnamed tributary approximately 700 meters upstream of its confluence with the Upper Kitwanga River. One cutthroat trout (10 centimeters) was captured downstream while no fish were captured upstream.

This culvert crossing was considered a partial barrier due to excessive water velocity inside the culvert. The culvert slope was 1 percent and created a high water velocity (0.62 meters/second), which may exceed the swimming capability of juvenile salmonids. The culvert outlet was not suspended (Photo 63). Fish habitat value was considered moderate upstream (shallow riffle pool, 1 percent slope, abundant cover) and poor downstream (cascade/riffle/pool complex, 20 percent slope, frequent debris jams). Located approximately 400 meters downstream is a deactivated crossing along an old grown-in logging road, which was visited in 2006 and deemed as passable to fish and well vegetated (McCarthy 2007). The total length of stream barred was estimated at 1500 meters (3,640 m^2), representing 68 percent of the total stream length.

A FHAP was carried out on this unnamed tributary of the Upper Kitwanga River to 1.0 km upstream of the Kitwanga FSR crossing. Fish habitat was considered poor throughout most the surveyed reaches (Photo 64). Although abundant LWD, SWD, and overstream vegetation was present, flow was minimal and frequent subsurface sections were observed. No bedrock-based barriers were encounter in the surveyed reaches. Survey terminated due to high frequency of subsurface flow sections and the absence of a defined channel upstream of Reach 3. Stream was logged to its banks and logging slash was present in the channel through entire survey length (Photo 65). More details can be found from digitized FHAP forms in Appendix III.

GFA recommended installing a series shallow rock levees at the culvert outlet to create slower moving backwater inside the culvert and removing a wood/rock debris jam located approximately 15 meters downstream. Works began with the dismantling of the debris jam. Prior to removal all the stream flow was channeling through a buried hollow log suspended over the stream channel below, which was considered a definite fish barrier (Photo 66). The GFA crew removed this log using hand tools, however the streambed could not be contoured to a slope that would allow for easy fish passage (Photo 67). This section requires further assessment and planning to create a channel passable to fish. A rock levee was installed below the culvert outlet. Prior to installation the water depth inside the culvert was approximately 5 centimeters. Rock was collected from the

surrounding area and placed by hand into the streambed (Photo 68). Following the installation, water depth inside the culvert increased to approximately 30 centimeters and water velocity was greatly reduced (Photo 69).

Photo 63: Culvert outlet at Site 61 prior to treatment (Kitwanga FSR).

Photo 64: Small waterfalls (0.5 meters) over organic debris in Reach 1.

Photo 65: Cut stumps adjacent to stream channel upstream of Site 61.

Photo 66: Water flowing though a hollow log 15 meters downstream of Site 61.

Photo 67: Channel following removal of debris jam at Site 61.

Photo 68: Hand placement of rock levee at Site 61.

Photo 69: Rock levee and backwatered culvert following treatment of Site 61.

3.2.3 Site 347 – 11 Mile Road

Site 347 is an old collapsed bridge crossing that has recently been rebuilt as an ATV crossing (Photos 70 and 71). Bridge timbers and road fill have plugged the channel creating a fish passage barrier (Koch and McCarthy 2008). Upstream of the crossing the stream consisted mainly of shallow riffles with numerous falls exceeding 0.5 meters. The stream flows subsurface through the crossing and reemerges below the crossing (Photo 72). Downstream of the crossing the stream consists of shallow riffle pool mix with occasional sections of subsurface flow. The stream enters a large beaver pond complex 600 meters downstream with numerous large beaver dams (Photo 73). The outlet into WRP Tributary 14 could not be found as shown on 1:20,000 TRIM. It was later determined that this stream drains into WRP Tributary 12 was found have no defined channel and no significant fish habitat by Biolith (1998). More details can be found from digitized FHAP forms in Appendix III.

Deactivation was recommended in 2007, however since this stream is likely non-fish bearing and provides only marginal fish habitat upstream of the crossing, minimal benefits would be expected from this action. No further works are recommended for this site.

Photo 70: Collapsing bridge deck at Site 347 (11 Mile Road Branch).

Photo 71: Recently constructed ATV crossing at Site 347.

Photo 72: Dammed pool created by collapsed road material upstream of Site 347 (Reach 1).

Photo 73: Abandoned beaver pond downstream of Site 347 creating subsurface flow.

3.2.4 Site 167 – Olive Branch Road

This site was deactivated when assessed in 2007, however the stream passes over an old collapsed unmapped bridge that appeared to create a fish barrier. Upstream of this crossing this channel was confined in a narrow gully with numerous cascade sections over bedrock. Fish trapping and electrofishing carried out downstream did not yield any fish. No foreseeable benefits would be gained by removing the collapsed bridge and therefore no further works are recommended.

3.2.5 Site 47 – Mitten Main

In 2006, Site 47 was assessed as a full barrier and ranked as a moderate priority crossing (SCQI Score = 35). The road crosses an unnamed tributary approximately 1.2 kilometers upstream of the Cranberry River confluence. One rainbow trout (11 centimeters in length) was captured in a "Gee" trap approximately 50 meters downstream of the culvert, while no fish were captured or sighted upstream during the 2006 assessment.

This crossing was considered a full barrier due to the excessive water velocity and insufficient water depth inside the culvert, an extreme outflow drop at the outlet (Photo 74), and a beaver dam constructed inside the culvert (Photo 75). The culvert slope was considered steep (6 percent) creating high water velocity (1.57 meters/sec) and low water depth (5 centimeters) inside the culvert. The water velocity exceeded the swimming capability of all juvenile salmonids. A suspended outlet was considered a barrier to all salmonids as it created 2-meter high plunge falls onto rock / wood debris below (no pool).

The stream habitat value was considered poor within 50 meters of the road crossing, as it was comprised mainly of shallow riffles with minimal deep pool habitat. Downstream of the culvert for the first 50 meters, the stream cascades through a bed of boulders creating numerous plunge falls that could restrict fish movement. The downstream section is well confined between steep canyon walls as opposed the upstream section which flowed within shallow channel walls. The road was likely designed to bypass the steep canyon section at its uppermost point. The gradient between the natural streambed on either side of the culvert was steep and possibly could have been a natural barrier prior to road construction. The total length of stream barred was estimated at 1.8 kilometers, representing 61 percent of the total stream length. The average gradient of the barred section is moderately steep at approximately 9 percent.

In 2008 a FHAP was undertaken upstream of the Mitten Main FSR (9U.530634.6164583) to a distance of 1060 meters. Four reaches were identified, which consisted of riffles pools and small cascades. Shallow veneer-glide over smooth bedrock was encountered at 30-45 meters (1-3 cm depth, 0.9-1.6 m/s, 18% grade) and 100-104 m (1-3 cm depth, 0.6-1.1 m/s, 15% grade). These sections are likely barriers to fish passage (Photo 76). No bedrock-based barriers were encountered upstream of these sections. More details can be found from digitized FHAP forms in Appendix III.

Fish sampling was attempted along Reach 2. Ten Gee traps set for 6 hours and spot sampling using an electrofisher in deep pools yielded no fish and no fish sighted throughout the survey. It is possible that the stream is no-fish bearing above the bedrock sections encountered at 30 and 100 meters upstream of the Mitten Main FSR (Photo 70). As such, replacing this culvert with an open bottom structure would provide minimal benefit.

Photo 74: Site 47 looking upstream at suspended outlet.

Photo 75: Site 47 looking downstream at submerged inlet - beaver dam inside culvert.

Photo 76: Shallow veneer flow over bedrock 30 meters upstream of the Mitten Main FSR at Site 47.

3.2.6 Wagon Creek Road – Sites 38, 40, 59, and 60

This road is located along the east side (right bank) of the Cranberry River connecting Hwy 37 N to the Mitten Main FSR. It is an unused road with several stream-crossing issues. Beavers have completely plugged the culverts at Sites 38 and 40 causing water to flow over the road, while metal culverts at Sites 59 and 60 were bent and collapsing. FHAPs were completed for each site and in all cases benefits gained by deactivation or structural replacement was considered minimal. However, the GFA crew identified two safety concerns during this survey that need attention by the BC MoFR.

Site 38 separates two large active beaver pond wetlands (Photo 77). A blocked culvert and a dam built against the upstream road edge caused water to flow over the road in several locations (Photo 78). Without a beaver management plan, deactivating this crossing would produce minimal benefits. No further works are recommended for this site.

Site 40 separates an active beaver pond upstream from an abandoned pond downstream (Photo 79). A blocked culvert and a dam built against the upstream road edge caused water to flow over the road in several locations (Photo 80). There was no defined channel downstream and water was flowing subsurface or consisted of stagnant pools. This stream provides poor fish habitat and therefore deactivation would produce minimal benefits. No further works are recommended for this site.

Site 59 was located immediately upstream of a series of beaver ponds that extended 250 meters to the Cranberry River (Photo 81). Approximately nine large beaver dams were encountered during a downstream walk with several structures that created waterfalls exceeding 1 meter in height (Photo 82). Without a beaver management plan, deactivating this crossing would produce minimal benefits. No further works are recommended for this site.

Site 60 was located along a small stream consisting mainly of shallow riffles. Approximately 120 meters upstream the GFA crew encountered bedrock-based falls/cascades that appeared impassable to fish (1.3 meter falls, 45 percent slope over 40 meters; Photo 83). Downstream of the crossing the stream drained into an extensive beaver pond complex located in an abandoned side channel of the Cranberry River (Photo 84). Due the fish barrier identified upstream, deactivating this crossing would produce minimal benefits. No further works are recommended for this site.

Two safety hazards were identified along this roadway. The first hazard is located 900 meters from the Hwy 37 N junction where the Cranberry River is eroding the roadbed (9U.540401.6157144; Photo 85). The second hazard is located 3.5 km from the Hwy 37 N junction where a large hole has developed in the roadbed from a collapsed wood-box culvert over a small seepage stream (Photo 86).

Photo 77: Large beaver pond complex upstream of Site 38, Wagon Creek Road.

Photo 78: Water flowing over road from culvert blocked by beavers at Site 38, Wagon Creek Road.

Photo 79: Beaver pond upstream of Site 40, Wagon Creek Road.

Photo 80: Water flowing over the road at Site 40, Wagon Creek Road.

Photo 81: Suspended culvert outlet at Site 59, Wagon Creek Road.

Photo 82: Beaver dam creating 1-meter high waterfalls downstream of Site 59, Wagon Creek Road.

Photo 83: Falls/cascades over bedrock 120 meters upstream of Site 60, Wagon Creek.

Photo 84: Beaver pond complex downstream of Site 60, Wagon Creek Road.

Photo 85: Cranberry River eroding Wagon Creek Road.

Photo 86: Large hole from collapsed wood-box culvert along Wagon Creek Road Km 3.4.

4. DISCUSSION AND RECOMMENDATIONS

Many worthwhile projects were carried out in 2008 and 2009. The deactivation of Site 91 at Kitwancool FRS Km 9.5 eliminated the risk of a road blowout and undue sedimentation of important sockeye spawning grounds in Gitanyow Lake. This site will need to be reseeded early in the 2009 growing season. Grass seeding greatly reduced the amount of sediment entering streams from crossings deactivated in 2007 and from exposed cutbanks along several logging roads. Rock armoring at Site 60 on the Kitwanga FSR eliminated further scouring from a suspended culvert. Landslide monitoring at Site 48 on the Kitwanga FSR will provide valuable information towards a workable stabilization plan. This site will need to be revisited in 2009 to collect this information.

Fish passage restoration was initiated at Site 3 and 60, however more work is required. At Site 3 on the Kitwanga FSR, a detailed site plan for a culvert replacement was prepared and submitted to the BC MoFR. GFA will seek funding in 2009 to carry out this project. At Site 61, the culvert was successfully backwatered, however a debris jam located immediately downstream could not be contoured to allow unrestricted fish passage with simple hand tool. GFA recommends that this site be reassessed in 2009 followed by the development of a viable restoration plan for this section.

The deactivation of the Canoe Creek Km 4 Branch Road was approved by BC MoFR but was not completed during this project period due to the early onset of winter and a deep snow pack. GFA will seek funding in 2009 to complete these works.

5. REFERENCES

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Appendix I

Site Description and Deactivation Prescription for NWFREP Site 91 at Km 9.5 on the Kitwancool FSR

Appendix II

Site Description and Deactivation Prescription for 4 Sites on the Canoe Creek Km 4 Branch Road

Appendix III

Digital copies of final report, site photographs, FHAP data forms, and stamped deactivation prescriptions